

SPIRAL GROWTH OF LEAD ON A COPPER (111) PLANE

SPIRAL growth during electrocrystallization when substrate and the deposited metals are the same, e.g., copper^{1,2} and silver³ have been reported. Spiral growth is also observed when titanium is electrodeposited from molten salt⁴ and during electrodeposition of silver-indium alloy⁵. So far no spiral growth is noticed during electrocrystallization when substrate and deposited metals are different. If the lattice misfit of the substrate and deposited metal is less than 14% there is epitaxial growth at least in thin deposits⁶. Both copper and lead are f.c.c. metals and the misfit for the case of $\{100\}\text{Cu}/\{100\}\text{Pb}$ matched on (100) planes is 36.8%. Similarly $\{111\}\text{Cu}/\{111\}\text{Pb}$ is 36.8%⁷. Generally it is expected that there would be no epitaxial growth of lead on copper. However Sang *et al.*⁷ have grown lead single crystals on the copper single crystal seeds from liquid pairs and have found that epitaxial lead crystals grow in the same crystallographic orientation. It is found during the literature survey that lead has not been electrodeposited on either polycrystalline or single crystal copper substrates. So it is felt that it would be interesting to electrodeposit lead on a single crystal of copper (111) plane.

The copper single crystal was fixed in a tygon tubing such that only (111) plane was exposed. This crystal was electropolished in 1:1 orthophosphoric acid bath⁸ and lead was deposited from a saturated ($\approx 1.7\text{ M}$) lead nitrate solution at various current densities in a three compartment cell⁹. The deposition was carried out at a particular current density and after a passage of 2 C/cm^2 the crystal was taken out and washed with distilled water and alcohol. The dried surface was examined under optical microscope and photomicrographs were taken.

It was found that lead started depositing at the edges of the copper crystal plane when current density was 1 mA/cm^2 . As the current density was increased, more and more surface of the crystal plane was covered and at 8 mA/cm^2 a uniform deposit was observed. Triangular spirals were observed even when the lead got deposited at the edges. Most of them were too faint to be photographed. Occasionally very well-defined triangular spirals were observed (Fig. 1). When the current density was increased, the distance between the consecutive steps decreased as was observed in the case of silver³. Further it was also noticed that very symmetrical hexagonal spirals (Fig. 2) began to grow along with triangular spirals as the current

density was increased. The spiral growth was highly reproducible.

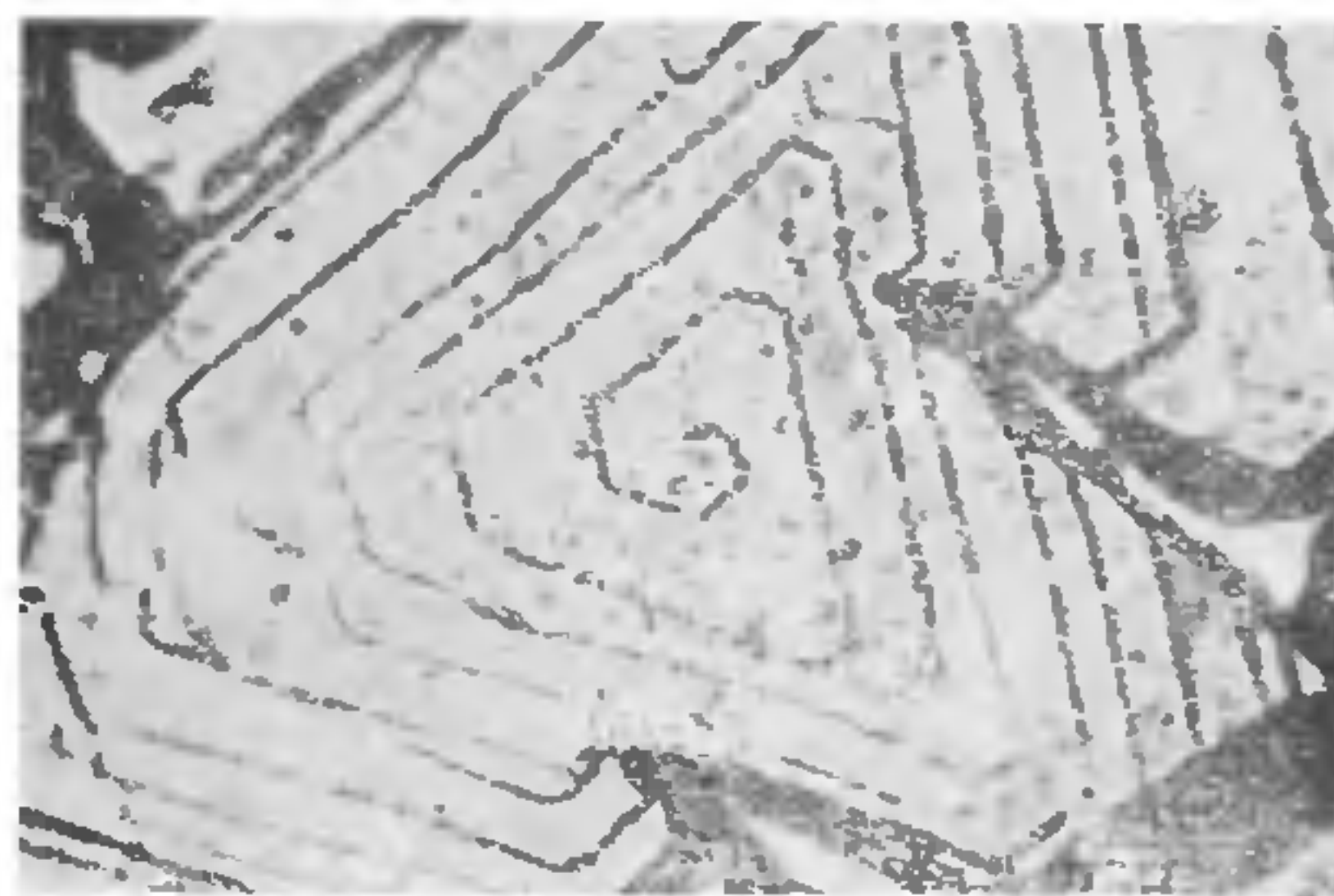


FIG. 1. Deposition of lead on a copper (111) plane from saturated lead nitrate solution at 1 mA/cm^2 , $\times 600$.



FIG. 2. Deposition of lead on a copper (111) plane from saturated lead nitrate solution at 8 mA/cm^2 , $\times 600$.

The above facts indicate that electrodeposited lead grows epitaxially on the copper (111) plane. It is known that larger misfits between the lattices of two metals produce the source of dislocations¹⁰. If these are screw dislocations the spiral growth of lead crystals could be explained in the light of Frank's theory¹¹ of crystal growth.

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STORAGE STABILITY OF ANTIMICROBIAL COTTON TEXTILE

CELLULOSIC materials are extremely susceptible to microbial attack. This is deleterious for the clothing and also may function as a source of microbial infection to the user particularly in the tropical climate. Many attempts have been made by several workers to impregnate certain chemicals in cotton textile to render them free from microbial attack, e.g., halogenated benzazole derivatives³, alkyl dimethyl benzyl ammonium chloride⁸, neomycin sulphate⁷ and T.H.P.C. melamine, etc. Antibacterial finishes have been imparted by various techniques such as fibre reaction, resin bonding², and thermosetting bacteriostatic resins⁵, etc. Similarly pentachlorophenol can be chemically attached to lignocellulosic fibres in water suspensions by a bridge derived from cyanuric acid.

With this view, a few chemically treated antimicrobial cotton textiles were prepared in an effort to find an effective fabric to prevent deteriorations due to micro-organisms. One such treatment was reported by Ghose and Maurya (1971)⁴ which consists of polymerising *in situ*, a urea-mercury compound (0.1% aq. solution) (w/v) with neutral-formaldehyde and final baking at 130°C for half an hour. Storage stability tests on the treated samples are reported here.

The samples prepared in June 1969, July 1970 and May 1971 were stored in a steel cabinet and their antimicrobial properties evaluated after three, two and one year of storage respectively. Antimicrobial studies were carried out immediately

after: (i) the preparation of the control samples; (ii) 25 washings; (iii) 3 hr boiling and (iv) 24 hr leaching. The samples exhibited remarkable antibacterial activity which persists even after various conditionings of the treated textile materials.

Antibacterial activity of the treated samples stored under ambient conditions are reported in Table I.

TABLE I

Antibacterial activity of cotton textiles treated with urea formaldehyde mercury compound (0.15)*

S. No.	Organisms used	Samples prepared in June 1969	Samples prepared in July 1970	Samples prepared in May 1971
1	<i>Salm. typhi</i>	.. 23.40	23.98	23.55
2	<i>Strept. faecalis</i>	.. 23.27	38.37	38.97
3	<i>Staph. aureus</i>	.. 28.50	28.73	30.88
4	<i>Staph. albus</i>	.. 25.50	28.68	29.30
5	<i>Strepto. pyogenes</i>	.. 29.00	34.17	38.85
6	<i>Bac. pumilus</i>	.. 24.15	27.36	28.20
7	<i>Bac. subtilis</i>	.. Traces	25.97	23.75
8	<i>Pseudo. pyocyanea</i>	.. 30.95	34.12	36.85

* (i) Average of three readings; (ii) Zone of inhibition expressed in mm.

In yet another study samples of cotton textiles were prepared by dipping them in 2% acinol (a proprietary product of Ahura Chemicals, Bombay) solution and drying in open air. The samples were prepared in February 1971. Follow-up studies revealed excellent antibacterial properties which, however, diminished on washing. Acinol (Cetyl Dimethyl Benzyl Chloride (CDMB-100) was originally prepared as a textile detergent which Rao *et al.*⁶ have established as a potent antimicrobial and antiseptic agent.

The antimicrobial properties of acinol treated samples were assessed after one and half years of similar ambient storage in a steel cabinet. The observations are recorded in Table II.

TABLE II

Antibacterial activity of cotton textiles treated with 2% acinol CDML-100**

S. No.	Organisms used	Samples prepared in February 1971
1	<i>Salm. typhi</i>	.. 34.32
2	<i>Strept. faecalis</i>	.. 33.87
3	<i>Staph. aureus</i>	.. 30.09
4	<i>Staph. albus</i>	.. 31.48
5	<i>Strept. pyogenes</i>	.. 34.25
6	<i>Pseudo. pyocyanea</i>	.. 30.10
7	<i>Bac. subtilis</i>	.. 30.52
8	<i>Bac. pumilus</i>	.. 27.62

* (i) Average of three readings; (ii) Zone of inhibition expressed in mm.